WHAT IS CLAIMED IS:

1. A method for non-contact measurement of microwave capacitance of miniature structures of integrated circuits, comprising the steps of:

positioning a near-field microwave probe at a predetermined distance from a miniature structure under the test;

measuring a resonant frequency f_s of said near-field microwave probe for said miniature structure under the test;

positioning said near-field microwave probe said predetermined distance from a uniform metallic structure;

measuring a resonant frequency f_c of said near-field microwave probe for said uniform metallic structure; and,

calculating the microwave capacitance C_s of said miniature structure under the test as

$$C_s = \frac{(f_e - f_c)(f_e - f_c)}{(f_s - f_c)4f_e^2 Z_0}$$

wherein f_e is the resonant frequency of said near-field microwave probe in air, and Z_0 is the characteristic impedance of said near-field microwave probe.

2. The method of Claim 1, wherein said near-field microwave probe includes a balanced two-conductor transmission line resonator.

3. The method of Claim 1, wherein the measurements are conducted at microwave frequencies.

4. The method of Claim 1, wherein said near-field microwave probe includes at least a pair of conductors extending in spaced relationship therebetween and separated by a dielectric medium.

5. The method of Claim 1, further comprising the steps of:

maintaining said distance between said near-field microwave probe and said uniform metallic structure equal to said predetermined distance between said near-field microwave probe and said miniature structure under the test by a closed-loop distance control mechanism.

6. The method of Claim 5, wherein said closed-loop distance control mechanism includes a shear force-based distance control mechanism.

7. The method of Claim 1, wherein said near-field microwave probe includes a tip, wherein an area of said uniform metallic structure is at least the size of a cross-section of said tip of said near-field microwave probe.

8. The method of Claim 1, wherein said predetermined distance is maintained below 50-100nm.

9. The method of Claim 1, further comprising the steps of:

measuring the absolute value of the first derivative of a power reflected from or transmitted through said near-field microwave probe as a function of a frequency of a signal applied thereto, and determining said resonant frequencies f_s and f_c by a numerical technique chosen from the group of numerical techniques, consisting of:

(a) determining the resonant frequency f_s and f_c as the frequency at the point on said measured curve where said measured curve has a minimum;

(b) determining the resonant frequency f_s and f_c as the frequency at the point of said measured curve where the first derivative of the measured power with respect to frequency equals zero and second derivative of the measured power is positive; and

(c) fitting the obtained measured curve to an even order polynomial, and finding the frequency where the first derivative of said polynomial equals to zero.

10. The method of Claim 1, wherein said uniform metallic structure is a contact pad.

11. The method of Claim 1, wherein said miniature structure includes an inter-digital capacitor.

12. The method of Claim 1, wherein said miniature structure includes a single metal wire or a trench in a dielectric.

13. The method of Claim 1, wherein said miniature structure includes an array of metal/dielectric trenches.

14. The method of Claim 1, wherein said miniature structure includes an array of interconnect lines.

15. The method of Claim 1, wherein said miniature structure includes a multi-layered structure.

16. The method of Claim 1, further comprising the steps of:

comparing said calculated microwave capacitance C_s with a predetermined capacitance value, and judging whether said miniature structure is defective based on a deviation of said C_s from said predetermined capacitance value.

17. A system for non-contact measurement of microwave capacitance of miniature structures of integrated circuits, comprising:

a miniature structure under the test,

a near-field microwave probe having a tip thereof,

a uniform metallic pad of the size approximately equal to the cross-section of said tip of said near-field microwave probe,

a shear force-based distance control unit operatively coupled to said near-field microwave probe to control tip-to-miniature structure separation and tip-to-uniform metallic pad separation,

acquisition means for acquiring resonant frequency f_s of said near-field microwave probe for said miniature structure and resonant frequency f_c of said near-field microwave probe for said uniform metallic pad, and

processing means for calculating the microwave capacitance C_s of said miniature structure under the test as

$$C_s = \frac{(f_e - f_c)(f_e - f_c)}{(f_s - f_c)4f_e^2 Z_0}$$

wherein f_e is the resonant frequency of said near-field microwave probe in air, and Z_0 is the characteristic impedance of said near-field microwave probe.

18. The system of Claim 17, wherein said near-field microwave probe includes a balanced two-conductor transmission line resonator.

19. The system of Claim 17, wherein said near-field microwave probe includes at least a pair of conductors extending in spaced relationship therebetween and separated by a dielectric media.

20. The system of Claim 17, further comprising means for comparing said calculated microwave capacitance C_s of said miniature structure under the test with a predetermined capacitance value, and for judging whether said miniature structure is defective based on deviation of said C_s from said predetermined capacitance value.